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 From: Jessica Branom-Zwick, Senior Associate
 Date: September 22, 2015
 Subject: Results of Updated Study to Assess the Private Stormwater Facility Inspection Schedule

Seattle Public Utilities' (SPU) Source Control Program works with private owners of stormwater facilities to ensure that systems are regularly maintained to prevent flooding, avoid property damage, and protect surface water quality. To comply with Special Condition S5.9.b in the NPDES Phase I Municipal Stormwater permit (permit), SPU must inspect private stormwater facilities connected to the municipal separate storm sewer system (MS4). The permit requires SPU to conduct inspections according to the standard schedule described in the permit or according to an alternative schedule supported by maintenance records or a written statement.

In 2010, SPU requested and received approval from the Washington State Department of Ecology to implement an alternative schedule with site inspections every two years. SPU's request was supported by an analysis of SPU inspection records conducted by Cascadia Consulting Group (Cascadia). In the 2010 study, Cascadia's analysis of special inspections of a random sample of 267 facilities found that overall, 80 percent of these facilities remained in compliance for at least one year.

To take advantage of four years of additional inspection data, SPU contracted with Cascadia to conduct a new analysis of SPU's inspection records to categorize sites based on their length of continued compliance, as described in the methodology section. Similar to the 2010 study, this new study sought to determine whether a) at least 80 percent of the 1,046 facilities with meaningful data remained in compliance for at least two years or b) whether land use played a factor in further determining inspection frequency. Based on the study results, SPU proposes to change the inspection frequency to every three years for facilities on single-family and multi-family residential sites, as shown in Table 1.

Table 1. Current and proposed alternative inspection schedules

Site Type	Current Schedule	Potential Alternative Schedule
Single-family and multi-family residential	Inspect every two years	Inspect every three years
Commercial, mixed use, church, school, and public	Inspect every two years	No change

SPU is seeking this change in inspection frequency because the data analyzed in this study indicate that most private stormwater facilities associated with single-family and multi-family residential sites remain in compliance between years two and three after inspection. Changing the inspection frequency from two years to three years will allow SPU and private properties to minimize the time that private stormwater facilities are out of compliance.

Key Findings

Overall, 80 percent of sites with meaningful data (described in the methodology section) remained in compliance for at least two years, although rates varied by subgroup:

- 82 percent of multi-family residential sites remained in compliance.
- 87 percent of single-family residential sites remained in compliance.
- 58 percent of commercial and mixed use sites remained in compliance.
- 68 percent of church, school, and public sites remained in compliance.

The analysis included the entire population of sites with meaningful data, which added up to 1,046 sites, or 71 percent of all sites in SPU's database. Meaningful data were much more available for multi-family residential (77% had meaningful data) and single-family residential (86%) sites than for commercial and mixed use (48%) and other (41%) sites.

Background and Methodology

Stormwater Inspection Process

Under its current inspection schedule, SPU inspects existing facilities every two years. These inspections may include multiple site visits and site-owner interactions that together constitute an inspection cycle. SPU's inspection cycle consists of four main steps:

1. **Notification Letter:** At least 10 business days before the inspection, SPU mails private stormwater facility owners a letter that:
 - Notifies them of the upcoming inspection.
 - Informs them of their right to accompany the inspector and schedule an appointment with the inspector.
 - Includes a "Drainage System Maintenance" brochure targeted toward property owners with a link to SPU's drainage website. This brochure was developed as a result of the EPA and Ecology audit in 2013 (attached).
2. **Onsite Inspection:** An SPU inspector visits the facility site to conduct an onsite inspection. If a site owner or manager is available and interested, the SPU inspector provides in-person education.
3. **Results Letter:** SPU mails a letter to the site owner informing them of the inspection results:
 - **In Compliance:** The letter states that no action is necessary as a result of the inspection and provides information on system maintenance.
 - **Out of Compliance:** The letter:
 - States actions the site owner must take.
 - Provides technical assistance (such as a map and drainage contractor list).
4. **Follow-up (only if out of compliance):** SPU works with the site owner using technical assistance and progressive enforcement until the stormwater facility is brought into compliance.

For site owners of facilities that are in compliance when they are inspected, inspections do not appear to be an effective tool for delivering education or motivating preventive facility maintenance to maintain compliance. While detailed records are not available, SPU site inspectors estimate that fewer than 5 percent of site owners accompany the inspector to learn about their facility and receive maintenance education. As a result, SPU believes that inspecting facilities when they are in compliance does not lengthen the compliance period and that education or maintenance reminders can be provided more cost-effectively outside of onsite inspections. **Moreover, to minimize days spent out of compliance, SPU believes that the optimal time to inspect a stormwater facility is immediately after it becomes out of compliance. An inspection finding of noncompliance leads to corrective maintenance and the opportunity to interact more closely with site owners when they are motivated to address their stormwater facilities.**

Stormwater Facility Population Characteristics

SPU's inspection records database contains 1,469 unique sites located in the MS4 area with private stormwater facilities. Sites are categorized into four main types:

- Single-family residential
- Multi-family residential
- Commercial and mixed use (both called "commercial" in this analysis)
- Church, school, and public (called "other" in this analysis)

Table 2 presents the number of sites in each category that are in SPU's inspection database.

Table 2. Inspection database sites counts, by type

Facility Type	Total Number of Sites
Multi-family residential	623
Single-family residential	444
Commercial	333
Other	69
Total	1,469

For each site, the database contains records of each inspection cycle, including the date of the inspection, whether the site was in or out of compliance, and the date the inspection cycle was closed (i.e., the date a noncompliant site was brought into compliance or the inspection date for sites already in compliance).

Sites have varying numbers of inspection cycles, depending on the age and type of the site. Before 2009, SPU did not regularly inspect residential sites, so these sites have fewer inspection cycles than commercial and other sites of similar ages. Because the two-year inspection schedule begins when a site is brought back into compliance, sites that have been found out of compliance and that took longer to come into compliance will also have fewer inspection cycles than similarly aged sites that have never been out of compliance.

Analytical Methodology

Cascadia's analysis began with the entire population of sites in SPU's inspection database that had data in 2009 or later. Earlier data were excluded because SPU began conducting inspections of all sites on a more frequent basis starting in 2009, to comply with the 2007 NPDES permit. The analysis sought to determine the most appropriate inspection frequency based on maintenance records with meaningful data. After initial examination of the available data, Cascadia and SPU determined that the analysis should compare the number of sites that remained in compliance for at least two years to the number of sites that went out of compliance within three years. Instead of using random sampling to select a subset of sites, the entire population of sites with data that provided meaningful information were included in the analysis. Meaningful information was determined based on the known periods of compliance or noncompliance for a site:

- **Meaningful information:**
 - Known to be in compliance at least two years (supporting the new schedule).
 - Known to be out of compliance within three years (not supporting the new schedule).
- **No meaningful information:**
 - Known to be in compliance, but records cover less than two years.
 - Known to be out of compliance, but the time between inspections was more than three years.
 - Not enough inspection data to determine compliance or noncompliance.

Sites were analyzed and categorized using the following steps:

1. **Calculate start date of compliance:** for the first inspection cycle (post-2008), the start of compliance was calculated as follows:
 - For sites that were in compliance: the start date is the *beginning* of the first inspection cycle (the first date the site was known to be in compliance).
 - For sites that were out of compliance: the start date is the *end* of the first inspection cycle (when the site was known to have been brought into compliance).
2. **Determine compliance status** in subsequent inspection cycles (called A, B, and C).
 - Note: Inspection cycles are labeled based on the number of inspection after a site's first inspection post-2008 and not based on a uniform set of years. For example:
 - A site whose first inspection was in 2009 would be scheduled to have its Cycle A inspection in 2011, Cycle B inspection in 2013, and Cycle C inspection in 2015.
 - A site whose first post-2008 inspection was near the end of 2013 would not be due for its Cycle A inspection until the end of 2015.
3. **Find known compliance and noncompliance dates, as shown in Table 3:**
 - For sites that were in compliance in Cycle A: find the latest date at which the site was known to be in compliance at the beginning of the inspection cycle. If a site also remained in compliance in Cycle B or in Cycles B and C, use the end-dates for the last inspection cycle in which the site was in compliance.
 - The period between the start date and the latest date when the site was known to be in compliance represents the minimum time the site was in compliance. Sites may have stayed in compliance longer than this known minimum, but data are not available to estimate the actual length of compliance.

- For sites that were out of compliance in Cycle A: find onsite inspection date for Cycle A:
 - If the time between the start date of compliance (defined in Step 1) and the inspection date for Cycle A is three years or less, it provides meaningful data: this site would be found out of compliance in the proposed 3-year inspection schedule.
 - Note: only 10 sites were found out of compliance in two years or less.
 - If the time between the start date and the inspection date for Cycle A is longer than three years, the site is excluded from analysis because it provides no meaningful information on whether the site would be in or out of compliance using the new proposed inspection schedule. For example, a site that was not inspected for four years may have stayed in compliance for three years and eleven months.
 - Note: Excluding these sites may result in overestimating the percentage of sites that remain in compliance.
- For sites that were not inspected a second time (i.e., have no Cycle A): exclude from analysis because they do not have enough data to provide meaningful information on the inspection schedule.¹

Table 3. Calculation of minimum compliance and failure dates

Compliance Start	Cycle A	Cycle B	Cycle C
	Out of compliance <i>Calculate using start of Cycle A; exclude if period is more than 3 years</i>	<i>not applicable</i>	<i>not applicable</i>
	In compliance <i>Calculate using end of Cycle A</i>	Out of compliance	<i>not applicable</i>
	In compliance	In compliance <i>Calculate using end of Cycle B</i>	Out of compliance
	In compliance	In compliance	In compliance <i>Calculate using end of Cycle C</i>
	No data <i>Exclude from analysis due to lack of data</i>	<i>no data</i>	<i>no data</i>

Note: Once a site was found out of compliance, subsequent inspection cycles were excluded because the analysis is based on a percentage of sites and not a percentage of inspections. This may result in more conservative estimates of the percentage of sites in compliance over time.

Using the start date and dates of known compliance or non-compliance, sites were classified into five categories:

- **Meaningful information (include in analysis):**
 - In compliance at least two years (supporting the new schedule).
 - Out of compliance within three years (not supporting the new schedule).
- **No meaningful information (excluded from analysis):**
 - In compliance, but records cover less than two years because the site was inspected too soon.
 - Out of compliance in Cycle A, but was inspected too late (gap is longer than three years).
 - Not enough inspection data (i.e., not inspected at least two times after 2008).ⁱ

Cascadia used these categorizations to conduct an analysis using sites with meaningful information to estimate compliance status in the first three years for sites that were found out of compliance but had not been inspected for more than three years. These methods are described in the following analytical results section.

Analytical Results

Using the analytical method described above, Cascadia calculated the number and percentage of sites that provide meaningful data to evaluate if lengthening the inspection schedule from two to three years is appropriate. Cascadia also calculated the number and percentage of sites that provide no meaningful information that should be excluded from this analysis.

Table 4 shows the number of sites in each of these categories. Overall, meaningful data are available for 71 percent of sites overall, with higher availability for multi-family (77%) and single-family (86%) residential sites.

Table 4. Categorization of all sites

Overall, meaningful data are available for 71 percent of sites overall, with higher availability for multi-family (77%) and single-family (86%) sites.

	Meaningful information		No meaningful information		Total Sites in SPU Database	
	Count	Percent	Count	Percent	Count	Percent
Multi-family	479	77%	144	23%	623	100%
Single-family	380	86%	64	14%	444	100%
Commercial	159	48%	174	52%	333	100%
Other	28	41%	41	59%	69	100%
Total	1,046	71%	423	29%	1,469	100%

Analysis

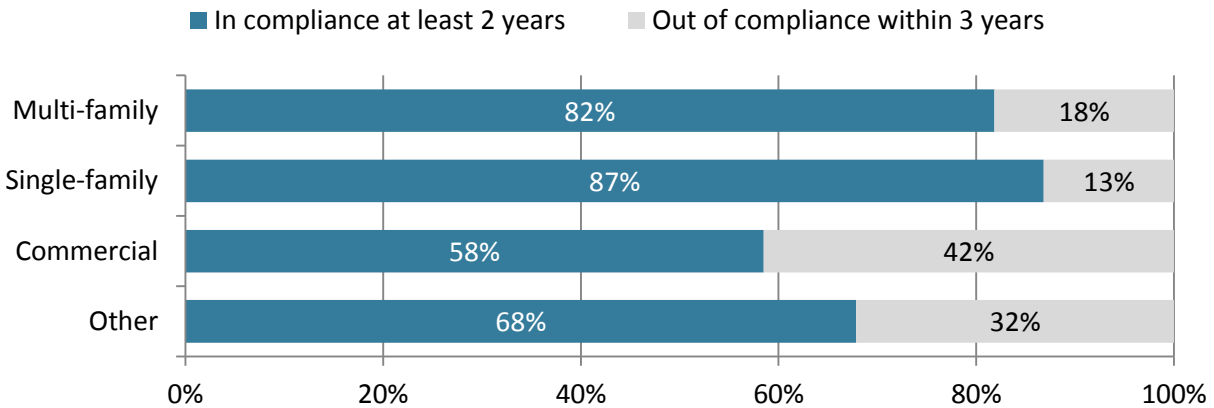
The next step was to conduct the analysis on sites with meaningful information (479 Multi-family, 380 single-family, 159 commercial, and 28 other). Table 5 and Figure 1 present the number and percentage of sites with meaningful information based on compliance status to evaluate if the site type met the 80-percent threshold in support of a three-year inspection schedule. Of the sites that had meaningful information, 82 percent of multi-family and 87 percent of single-family residential sites remained in compliance for at least two years.

Table 5. Categorization of sites with meaningful data

Overall, 80 percent of eligible sites were known to be in compliance for at least two years, with higher rates for multi-family (82%) and single-family (87%) sites.

	In compliance at least 2 years		Out of compliance within 3 years		Total Sites with Meaningful Information	
	Count	Percent	Count	Percent	Count	Percent
Multi-family	392	82%	87	18%	479	100%
Single-family	330	87%	50	13%	380	100%
Commercial	93	58%	66	42%	159	100%
Other	19	68%	9	32%	28	100%
Total	834	80%	212	20%	1,046	100%

Figure 1. Categorization of sites with meaningful data



Summary

Based on this analysis of SPU inspection records, 80 percent of all sites are estimated to remain in compliance for at least two years. However, SPU believes that sites on commercial and other land use types have a higher potential for pollution-generating activities onsite; therefore, SPU proposes to continue inspecting these sites every two years. A two-year schedule for commercial and other site types coincides with the frequency of SPU’s source control business inspections for high-priority business sites. SPU coordinates the timing of facility and business inspections to benefit both businesses and SPU.

SPU may decide to use this analysis to provide a written statement to the Department of Ecology requesting a new alternative schedule of three years for private stormwater facilities on multi-family and single-family residential sites, as shown in Table 6.

Table 6. Current and proposed alternative inspection schedules

Site Type	Current Schedule	Potential Alternative Schedule
Single-family and multi-family residential	Inspect every two years	Inspect every three years
Commercial, mixed use, church, school, and public	Inspect every two years	No change

ⁱ Inspection data may be missing if the site was not due for a second inspection during the analysis period, if the site was inadvertently not re-inspected on schedule, or if inspection data were inadvertently not entered into the database.